

What is claimed is:

1. A method of controlling a variable speed drive having a converter stage, a DC link stage, and an inverter stage, the method comprising the steps of:
 - providing an inverter stage having a plurality of inverters electrically connected in parallel to a DC link stage, each inverter of the plurality of inverters being configured to power a corresponding load;
 - generating a switching signal for each inverter of the plurality of inverters, the switching signal being operable to activate and deactivate the inverter to obtain a preselected output power and a preselected output frequency from the inverter; and
 - interleaving the switching signals for each inverter of the plurality of inverters to reduce RMS ripple current at the DC link stage.
2. The method of claim 1 wherein the step of generating a switching signal for each inverter of the plurality of inverters includes the step of providing a modulator for each inverter of the plurality of inverters to generate the switching signal for each inverter of the plurality of inverters.
3. The method of claim 2 wherein the step of generating a switching signal for each inverter of the plurality of inverters further includes the steps of:
 - inputting a carrier signal to each provided modulator; and
 - inputting a modulating signal to each provided modulator.
4. The method of claim 3 wherein the step of interleaving the switching signals for each inverter of the plurality of inverters includes the step of shifting the carrier signal input to each provided modulator by a predetermined phase shift.
5. The method of claim 4 wherein the predetermined phase shift of the carrier signal is between about 30 degrees and about 90 degrees.
6. The method of claim 4 wherein the plurality of inverters comprises two inverters and the predetermined phase shift is about 90 degrees.
7. The method of claim 4 wherein the plurality of inverters comprises three inverters and the predetermined phase shift is about 60 degrees.

8. The method of claim 4 wherein the plurality of inverters comprises two inverters and the predetermined phase shift is about 72 degrees.
9. The method of claim 3 wherein the step of interleaving the switching signals for each inverter of the plurality of inverters includes the step of shifting the modulating signal input to each provided modulator by a predetermined phase shift.
10. The method of claim 9 wherein the predetermined phase shift of the modulating signal is between about 30 degrees and about 90 degrees.
11. The method of claim 3 wherein the step of interleaving the switching signals for each inverter of the plurality of inverters includes the step of shifting the carrier signal input to each provided modulator by a predetermined time shift.
12. The method of claim 3 wherein the step of interleaving the switching signals for each inverter of the plurality of inverters includes the step of shifting the modulating signal input to each provided modulator by a predetermined time shift.
13. The method of claim 1 wherein:
 - the step of generating a switching signal for each inverter of the plurality of inverters includes the step of providing a modulator to generate a single switching signal; and
 - the step of interleaving the switching signals for each inverter of the plurality of inverters includes the steps of:
 - providing the single switching signal to one inverter of the plurality of inverters; and
 - delaying the single switching signal by predetermined amounts before providing the delayed single switching signals to the remaining inverters of the plurality of inverters.
14. A method of controlling a variable speed drive having a converter stage, a DC link stage, and an inverter stage, the method comprising the steps of:
 - providing a converter stage having an active converter connected to a DC link stage;

providing an inverter stage having at least one inverter electrically connected in parallel to the DC link stage;

generating a first switching signal for the active converter, the first switching signal being operable to activate and deactivate the active converter to generate a preselected DC voltage at a DC link stage;

generating a second switching signal for the at least one inverter, the second switching signal being operable to activate and deactivate the at least one inverter to obtain a preselected output power and preselected output frequency from the at least one inverter; and

interleaving the first switching signal and the second switching signal to reduce RMS ripple current at the DC link stage.

15. The method of claim 14 wherein:

the step of generating a first switching signal for the active converter includes the steps of:

providing a first modulator to generate the first switching signal for the active converter; and

inputting a carrier signal to the first modulator; and

the step of generating a second switching signal for the at least one inverter includes the steps of:

providing a second modulator to generate the second switching signal for the at least one inverter; and

inputting the carrier signal to the second modulator.

16. The method of claim 15 wherein the step of interleaving the first switching signal and the second switching signal includes the step of shifting the carrier signal input to the second modulator by a predetermined phase shift.

17. The method of claim 16 wherein the predetermined phase shift of the carrier signal input to the second module is between about 30 degrees and about 90 degrees.

18. The method of claim 17 wherein the predetermined phase shift of the carrier signal input to the second module is about 90 degrees.

19. A variable speed drive comprising:

a converter stage to convert an AC voltage to a DC voltage, the converter stage being configured to be electrically connectable to an AC power source;

a DC link stage to filter and store energy from the converter stage, the DC link stage being electrically connected to the converter stage;

an inverter stage comprising a plurality of inverters electrically connected in parallel to the DC link stage, each inverter of the plurality of inverters being configured to convert a DC voltage to an AC voltage to power a corresponding load;

a control system to control operation of the inverter stage, the control system being configured to generate switching signals for each inverter of the plurality of inverters; and

wherein the switching signals for each inverter of the plurality of inverters are interleaved with the switching signals for the other inverters of the plurality of inverters.

20. The variable speed drive of claim 19 wherein the control system comprises a plurality of pulse width modulation (PWM) modulators, and each PWM modulator corresponding to an inverter of the plurality of inverters, being configured to generate a switching signal for the corresponding inverter, and including a carrier signal input to receive a carrier signal and a modulating signal input to receive a modulating signal.

21. The variable speed drive of claim 20 wherein the control system is configured to shift the carrier signal provided to the carrier signal inputs of the plurality of PWM modulators by a predetermined phase shift.

22. The variable speed drive of claim 21 wherein the predetermined phase shift of the carrier signal is between about 30 degrees and about 90 degrees.

23. The variable speed drive of claim 22 wherein the plurality of inverters comprises two inverters and the predetermined phase shift is about 90 degrees.

24. The variable speed drive of claim 22 wherein the plurality of inverters comprises three inverters and the predetermined phase shift is about 60 degrees.
25. The variable speed drive of claim 22 wherein the plurality of inverters comprises two inverters and the predetermined phase shift is about 72 degrees.
26. The variable speed drive of claim 20 wherein the control system is configured to shift the modulating signal provided to the modulating signal inputs of the plurality of PWM modulators by a predetermined phase shift.
27. The variable speed drive of claim 26 wherein the predetermined phase shift of the modulating signal is between about 30 degrees and about 90 degrees.
28. The variable speed drive of claim 20 wherein the control system is configured to shift the carrier signal provided to the carrier signal inputs of the plurality of PWM modulators by a predetermined time shift.
29. The variable speed drive of claim 20 wherein the control system is configured to shift the modulating signal provided to the modulating signal inputs of the plurality of PWM modulators by a predetermined time shift.
30. The variable speed drive of claim 19 wherein the interleaving of the switching signals for each inverter of the plurality of inverters results in a reduced RMS ripple current in the DC link stage.
31. A chiller system comprising:
 - a first refrigerant circuit, the first refrigerant circuit comprising a first compressor driven by a first motor, a first condenser arrangement and a first evaporator arrangement connected in a closed refrigerant loop;
 - a second refrigerant circuit, the second refrigerant circuit comprising a second compressor driven by a second motor, a second condenser arrangement and a second evaporator arrangement connected in a closed refrigerant loop;
 - a variable speed drive comprising:
 - a converter stage to convert an AC voltage to a DC voltage, the converter stage being configured to be electrically connectable to an AC power source;

a DC link stage to filter and store energy from the converter stage, the DC link stage being electrically connected to the converter stage; and

an inverter stage comprising a first inverter and a second inverter each electrically connected in parallel to the DC link stage, the first inverter being configured to convert a DC voltage to an AC voltage to power the first motor, and the second inverter being configured to convert a DC voltage to an AC voltage to power the second motor;

a control panel to control operation of the variable speed drive, the control system being configured to generate switching signals for the first inverter and the second inverter; and

wherein the switching signals for the first inverter are interleaved with the switching signals for the second inverter to reduce an RMS ripple current in the DC link stage.

32. The chiller system of claim 31 wherein the control panel comprises a first pulse width modulation (PWM) modulator to generate a switching signal for the first inverter and a second PWM modulator to generate a switching signal for the second inverter, the first PWM modulator and the second PWM modulator each including a carrier signal input to receive a carrier signal and a modulating signal input to receive a modulating signal.
33. The chiller system of claim 32 wherein the control panel is configured to shift the carrier signal provided to one of the first PWM modulator and the second PWM modulator.
34. The chiller system of claim 33 wherein the carrier signal is shifted by one of a predetermined phase shift or a predetermined time shift.
35. The chiller system of claim 34 wherein the predetermined phase shift is between about 30 degrees and about 90 degrees.

36. The chiller system of claim 32 wherein the control panel is configured to shift the modulating signal provided to one of the first PWM modulator and the second PWM modulator.

37. The chiller system of claim 32 wherein:

the converter stage comprises an active converter;

the control panel comprises a third PWM modulator to generate a switching signal for the active converter, the third PWM modulator including a carrier signal input to receive a carrier signal and a modulating signal input to receive a modulating signal; and

the control panel is configured to shift the carrier signal provided to the third PWM modulator to interleave the switching signal for the active converter with the switching signals for the first inverter and the second inverter.